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The Tin Position

THERE would appear to be two views about the announcement made by the Tin Council at its recent meetings. One view is that the disclosure of the unexpectedly large buffer stock holdings at the end of March means that the manager must be nearing the exhaustion of his resources. Since then he has bought a large quantity of metal and, it is said, he must now have at least 3,000 tons above the 22,400 he held at that time. The further cuts in the export quota for the last quarter from 40 per cent to 48 per cent, it is argued, is a desperate measure to save the Restriction Scheme from collapse, and as they will only affect supplies next year the present price outlook is unfavourable.

The second view, and one which is held by A. Strauss and Company Limited, takes a different line. In their latest review of the situation Strauss gives point to this view the holders of which say that at the present rate of consumption, without taking into account any prospect of improvement, demand will exceed supplies by such a large margin that whether the buffer stock manager is able to buy much more, a little more, or no more at all, is irrelevant. The buffer stock fulfilled its function by taking up the surplus at a time when supplies substantially exceeded demand, and in the absence of unforeseeable emergencies, it may have very little further role to play. But of course the feeling that the buffer stock may not be able to take up much more metal (the extent of the "special fund" on which the manager has presumably been recently drawing is unknown) may well have a pyschological effect on market sentiment.

According to the Strauss review this more optimistic conclusion is based on the following view of current and prospective consumption. The present rate of annual consumption in the United States is estimated at 48,000 tons. This compares with 60,000 in 1956 and 54,500 in 1957. Other countries are using tin at an annual rate of about 85,000 tons, compared with 102,000 last year. This makes a total of 133,000 as against the pre-recession figure of 160,000. If there is any error in these estimates it is considered that it is on the low side.

Assuming the present rate of consumption will continue for the next twelve months, how much metal will be available to meet it? Figures given by Strauss show that from the countries operating the restriction quota there will be 43,000 tons for the remainder of the year and 40,000 tons for the first half of 1959, making 83,000 tons over the next twelve months. The amount of metal that Russia and China will export is of course unknown but current guesses are that it will be 15,000 tons for this year. For the sake of the present calculation the figure is put at 20,000 for the ensuing twelve months. The other non-restriction countries can be estimated with reasonable accuracy at 10,000 tons. That makes a total of 113,000 tons—a deficit of 20,000 tons for the year against the consumption figure of 133,000 tons.

It must of course be borne in mind when relating supply and consumption figures to price changes that in the short run it is demand rather than consumption that counts. Sooner or later the balance between supply and consumption must reflect itself in the price and the longer that consumers hold off the market the sharper will be the upward reaction when they do finally decide to enter it.

Out of the MELTING POT

New Product

FLUID coke is produced in a process in which a petroleum oil, usually a low value heavy residual oil, is converted by pyrolysis to relatively lighter hydrocarbons and coke by contact with finely divided heat-carrying solid particles maintained at a temperature in the range of 850° to 1,500°F., or above. The heat-carrying solids are preferably maintained as a fluid bed in the coking zone. The coke produced by pyrolysis deposits on the fluidized solids, layer by layer, and becomes a part of them. The heat-carrying solids normally used are coke particles produced by the process. In this way, the fluid coke obtained is of uniform composition. The product has a particle size in the range of about 18 to 400 U.S. sieve number, the average particle size normally being in the range of 45 to 70. The particles have a spherical or ovoid shape, a laminar structure, and a high density and hardness. The ash content (e.g. 0·6 per cent) and the sulphur content (e.g. 7 per cent) depend on the oil feed used. The density of the fluid coke can be increased and its sulphur content can be reduced by calcination at high temperature and/or special desulphurizing treatments in which it is heated and fluidized with a gas containing oxygen or treated with hydrogen. By such means, the sulphur content is reduced to 2 per cent or less, and the true density is increased from 1·48 for the raw coke to about 1·9 gm/cm^3. The bulk density of the material is 9·6 lb/ft^3. So much for the production and properties of fluid coke. Its interest to the metals industry, in case you have been wondering, arises from the discovery (by the oil industry, be it noted) that fluid coke with a sulphur content of less than 7 per cent is a superior substitute for sand, which it can partly or wholly replace in green and dry moulds, green and baked cores, mould facings, shell moulds, etc. Moulds made of fluid coke with the usual binders, and using the ordinary moulding procedures, are suitable for casting both ferrous and non-ferrous metals. They yield castings with a better surface finish. The improved heat-transfer of the fluid coke moulds results in more rapid cooling and, consequently, a finer grain size, while their lower thermal expansion (one-tenth to one-seventh of a conventional sand mould) permits the use of smaller and/or fewer risers, and eliminates troubles caused by expansion-contraction forces between mould and casting. The bulk density of fluid coke being about 20 per cent less than that of ordinary moulding sand, decreases handling costs. Finally, the material when used in moulds suffers no substantial loss and can be re-used.

In Common

IN any process of manufacture, materials, raw or otherwise, invariably come first. This leading position is one of the reasons why materials are so often considered on their own as just materials. Another reason why this is done and can, in fact, be done with such relative ease, are the properties of materials. However diverse the materials and however varied their properties, it still remains possible to compare materials on the basis of their properties. Even the proverbial chalk can be compared with the ditto cheese on the basis of, for example, density or compressive strength. The usefulness of some of these comparisons is, of course, another matter. In so far as properties can be assigned numerical values, however, the temptation to compare them will remain and will, moreover, benefit from the appearance of exactness always associated with figures. So much for materials. The second position in any manufacturing process is occupied by the methods of manufacture. They are, of course, related in various ways to the materials being used and to the products it is desired to manufacture. By contrast with materials, however, methods of manufacture suffer from the serious disadvantage of having no properties that would permit their being considered in a simple, orderly and apparently exact manner. Whereas the mechanical properties of a metal in the cast and wrought conditions can be tabulated side by side, and subsequently surveyed and compared at a glance, a comparison—if comparison it is—between casting and forging requires the telling of quite a long and, it must be admitted, somewhat inconclusive story. Other methods have their own stories with very little or nothing in common. This lack of common ground is due to the superficial level at which methods of manufacture are considered. It would be most desirable if some of the zeal expended on determining properties of materials were to be diverted to a search for the common denominators of the growing number of methods of manufacturing materials.

Happier Medium

MUCH sound advice has been dispensed on the subject of writing technical reports. The need to use simple words which those in exalted positions will be able to understand, the need for punctuation which they will not notice, and the use of paragraphs which they will be able to skip—all these and other points have been discussed over and over again. Elsewhere, scientific and technical societies who engage in publishing activities have been making available instructions to prospective authors telling them, essentially, to be brief and to the point, and to abide by the particular society's practices in regard to illustrations, bibliographic references, etc. All this admirable advice leaves aside the equally, if not more, important consideration of the form which the author's material is to assume. Whether it be a Paper, article, report, survey or abstract, this form is assumed to be traditionally prescribed, and is more or less taken for granted. Little or no consideration seems to have been given to the possibilities of other forms in which to present scientific and technical information. The inevitable evolution of traditional forms of presentation has, likewise inevitably, been slow and ineffective. It has still a long way to go before it will have achieved any marked improvement in the ease with which the reader can absorb the information being presented and—a more important and much neglected point—any marked improvement in the benefit he is likely to derive from such absorption. Apart from the above evolutionary process, there has also been practised an increased adoption of the presentation of scientific and technical information as "news." The results of this form of presentation, unfortunately, very often leave one uncertain as to whether those concerned appreciate the difference between the news that, say, a vacuum casting process has been developed and the literal news that, for instance, some film star has divorced her fourth husband. The best form in which to present scientific and technical information still remains to be sought somewhere between "literature" and "news."

Skimmer

Finishing Supplement

Ultrasonics in Finishing

By D. J. FISHLOCK

COMMERCIAL usage of highly-concentrated sound energy, at frequencies beyond the audible limit of about 18 kc/s is now widely manifest. Applications range from flaw detection in materials, where a discontinuity can be registered on a cathode ray tube screen, to the not-altogether-successful attempts made to dislodge pigeons from Trafalgar Square by making a noise offensive to the birds yet inaudible to *homo sapiens*.

Recently, its value as a new source of agitation for liquids has been demonstrated, and whole new vistas are thus revealed for the metal finishing industry. By its use, not only can solutions of all types be agitated without risk of contamination or decomposition, but far more vigorously and effectively than by either air or the various forms of mechanical stirring. This application is not entirely new, incidentally, since it has been used to shake textiles free from dirt for some years.

Like all promising new developments, while the advantages and possibilities are obvious, closer examination reveals certain limitations. In this case, the major one has undoubtedly been the cost of generating the ultrasonic energy. The past two years, however, have seen considerable progress towards ameliorating this restriction, owing mainly to the application of much lower frequencies than were hitherto believed necessary, i.e. 20 to 175 kc/s instead of upwards of 400 kc/s. These lower frequencies can be generated electromechanically instead of electronically, at much lower cost and can be utilized at a higher efficiency—an effective double saving.

Ultrasonic generators are of two types, the comparatively low power valve generator, with a practical limit of some 5 kW, and the more efficient high power alternator, which has reached at least 18 kW and will certainly go higher. The former is convenient for laboratory and pilot plant use, since for low outputs it is small and compact, and is tunable over a range of frequencies. Above 3 kW or 4 kW, however, it becomes inordinately bulky and expensive, and requires much maintenance; here, the motor alternator comes into its own.

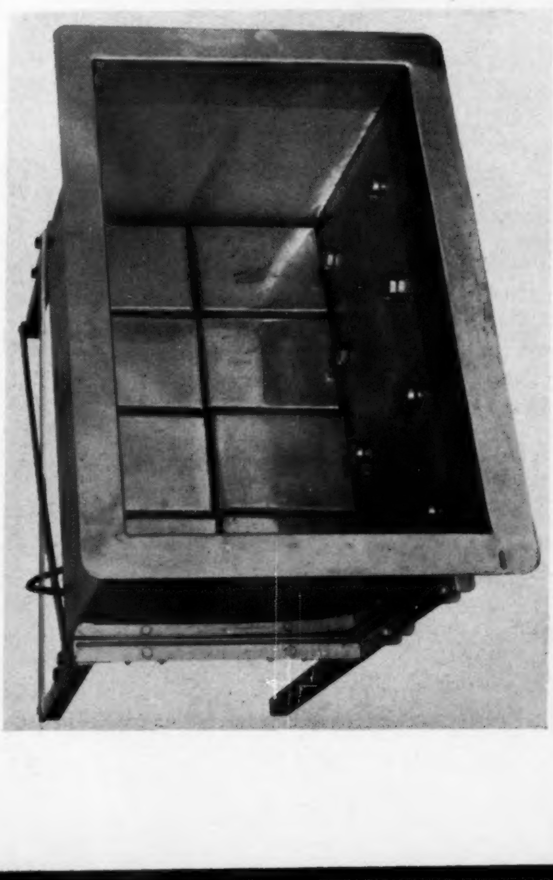
Valve Generators

Two years ago, little was known of the possibilities of the motor alternator; and nearly all the ultrasonic energy was produced by valve oscillators. These are mains fed, the 230 V. supply being transformed up to 10-20 kV. and fed to the oscillator. The resulting high frequency energy is then fed to the transducer. This comprises a piezo-electric crystal, i.e. a crystal which, when an alternating voltage is impressed across it, will vibrate at the same frequency. Quartz is the best-known example, but requires high voltages, of the order of 1,500 V., while it tends to be brittle and—a very important point — cannot easily be shaped. More recently, such synthetic ceramics as barium titanate have tended to supplant it, these needing only about 120 V., thus eliminating one hazard, while they can be moulded to the requisite size and shape. These are widely used both here and in the U.S.A.; they are of low efficiency, however, since much of the energy is used in heating them.

The transducer is located within the tank of liquid which it is required to agitate (Fig. 1). Since the ultrasonic energy radiates from it in straight lines, it must face the work and should have an area roughly equal to that of the work. Of course, this can be reduced by arranging for the work to pass or to be rotated before the transducer. Some idea of the size of the generator needed can be gauged from the rating of a typical German one, which has a 4 kW input and yields a maximum output of 1·5 kW, which can be used to activate a transducer area of up to 300 cm^2 (say 6 in. by 8 in.); further, there is some 50 per cent loss of power across the transducer itself, giving a final energy output of 2·5 w/cm^2.

Motor Alternators

It is undoubtedly upon motor alternator machines that the future industrial application of ultrasonic energy in metal finishing depends. The latest machines, already in use both in the U.S.A. and Germany (Fig. 2), have been evolved from machines developed 50 years ago to power wireless telegraphy transmitters. These have metamorphosed into high efficiency, smooth and quiet-running machines with a high power output, at between 20 and 175 kc/s. They are, in effect, motor generators, consisting of an electric drive motor superimposed on the H.F. alternator; the latter is water-jacketed for cooling, an expedient which very effectively silences the machine. In contrast to its electronic



[Courtesy Dawe Instruments Limited

Fig. 1—Cleaning tank equipped with stainless steel transducers

[Courtesy Roto-Finish Ltd.

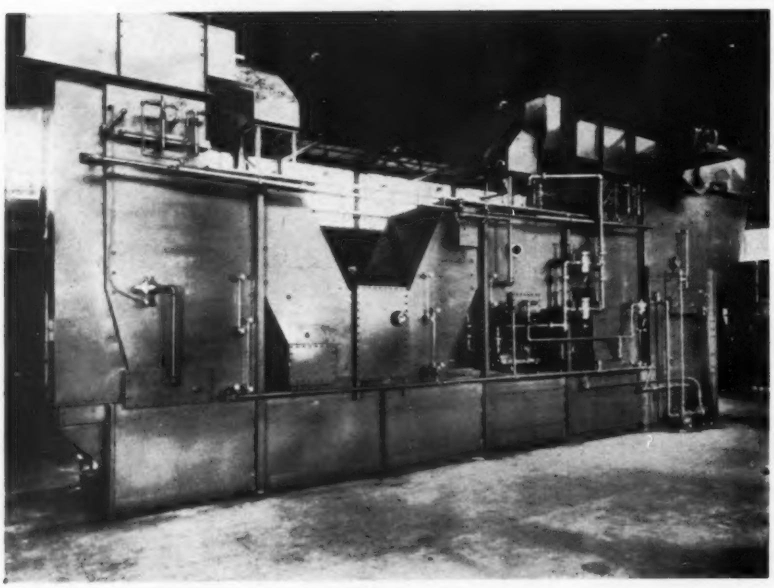
Above: Fig. 2—Rotary high frequency generators for ultrasonic installations

[Courtesy G. S. Blakeslee & Co.

Left: Fig. 3—Two magnetostrictive transducers

[Courtesy Roto-Finish Ltd.

Below: Fig. 4—Large conveyorized ultrasonic degreasing machine



counterpart it requires very little maintenance, while its efficiency is somewhat higher—up to 50 per cent of the input.

The transducers used in conjunction with these lower frequencies are magneto-strictive nickel ones, which offer many advantages over the crystal types—not the least important being a "transmitting" efficiency of about 90 instead of 50 per cent. They are much more robust, and can be made in any desired size or shape (Fig. 3). In construction they comprise a sandwich of nickel laminations (or occasionally a nickel rod or disc) which vibrates in sympathy with the applied alternating voltage. They can also be made of cobalt, while they are most efficient below 40 kc/s. If required to function in a corrosive medium they can be insulated.

Solution Agitation

The importance of solution agitation in almost every branch of "wet" metal finishing needs no emphasis. Electro and chemical brightening solutions are probably the only exceptions, where a viscous film which appreciably differs from the composition of the bulk of the solution is desirable on the work surface. In other treatments—plating, pickling, degreasing, conversion coating, etc.—some degree of agitation is invariably desirable to avoid polarization and to ensure continual replenishment of ions as they react with, or plate out on to, the work. In cleaning operations, use is made of the mechanical force of agitation to dislodge and keep in suspension scales and soil deposits. Ultrasonic agitation offers a peculiarly effective means of achieving this motion within a liquid. The vibrating transducer causes a most violent disturbance of the liquid in direct line with its radiating surface, and considerable shearing forces are exerted, although the surface turbulence, unavoidable when using air agitation, is largely absent.

Cleaning

The application of this form of agitation to cleaning operations was the first which attracted attention, and it is to-day the most widely developed and promising sphere. Ultrasonic cleaning makes use of comparatively mild agents, often at low temperatures, yet can achieve 100 per cent cleansing of the most intricate components, and removal of the most stubborn deposits in a startlingly short time. The most generally suitable solvents are chlorinated hydrocarbons, although almost any solvent can be used: some, however, such as benzene and carbon disulphide, have a high absorption of ultrasonic energy, while some allow bubbles to accumulate on the surface of the transducer which suppresses the ultrasonic energy.

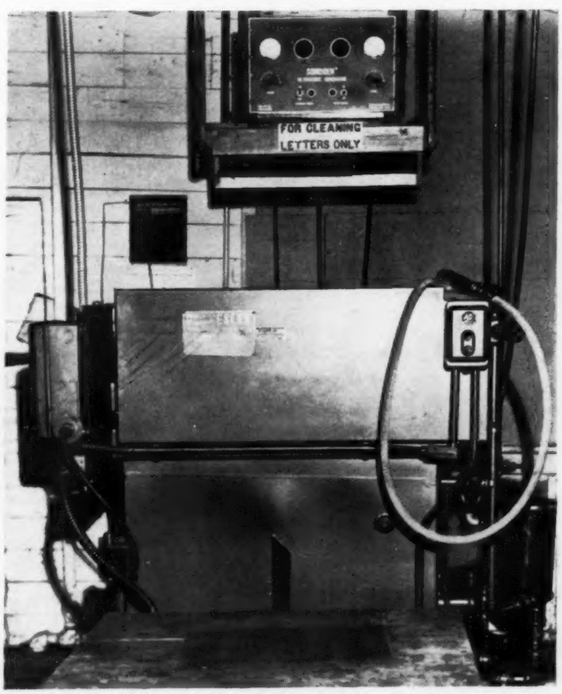
In the U.S.A., trichloroethylene plants have been designed incorporating a vapour, liquor rinse, ultrasonic

Fig. 5—Work immersed in the ultrasonically agitated liquor stage of a vapour degreasing plant

agitated rinse and, finally, a distillate spray stage (Figs. 4 and 5). Chemical (alkaline) cleaners can also be used, although generally speaking there is little to be gained. Indeed, some of the most effective cleaning is performed using only water, an example being the removal of polishing rouge from glass lenses. Photographic proof is available that in this case the rouge is literally blasted from the glass in a second or two, while the alternative, to achieve the same degree of brilliance, is a laborious individual hand-cleaning operation. A similar example is the rapid removal of crack-detection pastes from interstices and pores.

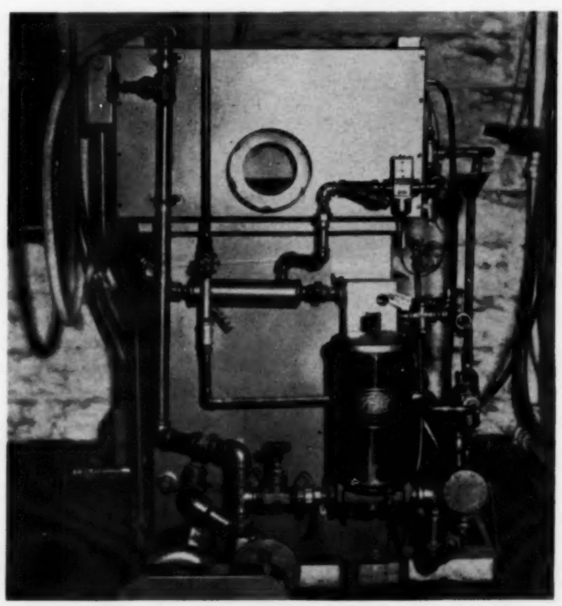
Thus far, in view of the capital cost of the generator, ultrasonic cleaning has been largely restricted to very small work, and especially work which required a very high standard of cleanliness. Very small units, Figs. 6, 7 and 8, are now generally available wherein such components as watch and clock movements, servo-mechanisms, electric razor heads, minute threaded parts, fuel injectors, hypodermic needles, and so on, can be treated to a standard of cleanliness hitherto unattainable; further, this operation rarely requires more than 30 sec. The chief limitation imposed on processing speed arises from the need to keep the cleaning fluid completely free from suspended matter. The reasons for this are two-fold; first, this prevents it from redepositing when the work is removed from the area of maximum agitation, and second, the energy itself is easily absorbed by suspended particles. A high-speed filtration system is, therefore, a vital ancillary of this equipment. Fig. 9 demonstrates a self-contained, automatic degreasing unit for treating assembled ball and roller bearing races. This can handle 5,000 races of 30 mm. dia. per 8 hr. shift, using two agitated cleaning stages. The solvent, petroleum, is continuously clarified by a built-in filtration system.

As previously noted, the turbulence is not uniform throughout the liquid but is concentrated in line with the radiating face(s) of the transducer. Unless, therefore, sufficient transducers can be so disposed as to embrace all faces of the work — an expensive proposition, bearing in mind that they usually function in cleaning at about 2 to 5 w/cm^2 — the work must be arranged to pass through or rotate in the area of maximum agitation. This can be done manually or by using a barrel, for instance. Further, by using concave ceramic transducers, i.e. with high frequencies, very intense concentrations of energy can be achieved at their focal point. In one large trichloroethylene plant, energies of 5 to



Figs. 6 and 7—Small ultrasonic degreaser, equipped with heat exchanger, 10 micron solvent filter and recirculating system

[Courtesy G. S. Blakeslee & Co.



10 w/cm^2 at the transducer surface are concentrated to several thousand w/cm^2.

There are two interesting characteristics of the low frequency energy which require mentioning. One, cavitation, is the mechánism largely responsible for the speed and incomparable efficiency for ultrasonically agitated cleaning. The vibration of the transducer produces a corresponding motion within the liquid, which might be termed a micro-turbulence. Cavitation is an altogether more vigorous motion which, although as yet not entirely explicable, manifests itself as the formation of voids usually on the surface of the work in the region of pores and fissures. It is believed that minute air bubbles trapped in such discontinuities act as nucleating centres for the vacuum bubbles. These voids soon collapse with almost explosive violence and with the momentary dispersion of considerable energy as shock-waves—in effect producing a macro-turbulence right at the work surface. In addition, the formation of a vacuum over a pore tends to suck soils out. Cavitation must be kept strictly under control in view of its vigour; it increases in intensity with increasing solution temperature and energy concentration. Indeed, under some conditions it can seriously erode a metal, although this does not arise in cleaning, due to the very brief treatment times. Brittle materials are also liable to be shattered at high energy levels.

The second characteristic is the greater propensity for the lower frequencies to bend themselves around the work, thus giving a more uniform agitation with no "sonic shadow" or region in which soil may resettle. Several years of experience with frequencies ranging from 20 to 3,000 kc/s have demonstrated, therefore, that, economic advantages apart, there are very sound practical advantages in using low frequencies. To-day, except for very small production units and experimental plant, the electromechanically generated energy is used by industry almost exclusively, and commensurately small motor generators are becoming available.

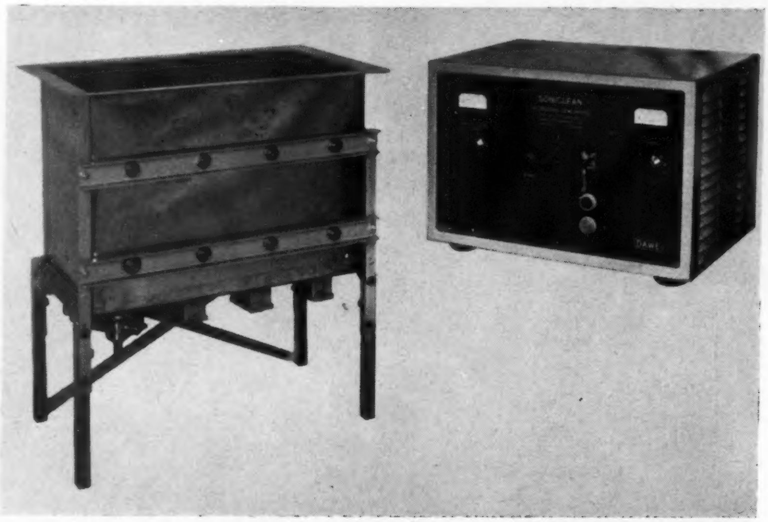


Fig. 8—A tunable 36-40 kc/s valve ultrasonic generator [Courtesy Dawe Instruments Ltd

Many illustrations can be given of the exceptional cleansing properties of ultrasonically agitated fluids, such as the one where it is used to clean watch movements to such a high standard that they then have to be artificially "recontaminated" with stearic acid vapour to raise the interfacial tension and enable them to retain the traces of lubricating oil. Few, however, have greater propensity than the German application for the continuous cleaning of steel strip. At least two German factories are using this process; the Kaltwalzwerk Brockhaus cold-rolling mill at Plettenberg, Fig. 10, treats the strip after shot-blasting in order to dislodge the very fine, clinging dust particles which spoil the finish of the band after chromium plating. Water, with corrosion inhibitors, is the fluid used, the strip travelling between a double bank of transducers placed 0·125 in. or less from each side. It is then water-rinsed finally to remove loose particles. Rotary generators, of the type described above, supply the energy, while the fluid is continuously filtered at high speed through kieselguhr. This method has not only been found entirely effective, in contrast to all conventional cleaning methods, but has proved economical to use. At the nearby Schade Wprks, the process is also used for cleaning strip steel where it has supplanted a pickling operation and thus eliminated an effluent disposal problem; here, about 15 tons of strip is cleaned per 8 hr. shift, in a plant which, including a mechanical scouring stage, is some 90 ft. long. It would appear, therefore, that this modified cleaning process has a considerable future as a pre-plating treatment whereby such notoriously difficult deposits as buffing residues might be rapidly and completely dispersed.

[Courtesy Roto-Finish Ltd.

Fig. 9—Automatic ultrasonic cleaning plant manufactured by Schoeller & Co., Frankfurt, for the cleaning of assembled ball and roller races

Electroplating

The application of this energy to plating electrolytes has been a story of very spectacular claims, followed only too often by disappointment and disillusionment, both at the results and at the economics. A clearer picture is now emerging of the possible advantages, while the developments in generator design have certainly solved the cost problem. Nearly all the work to date has been of an experimental nature, although a recent American report claims that some 14 plants there have ordered larger equipment to extend their developments to at least pilot-plant status. The earlier work again utilized the higher frequencies,

but more recent indications are that frequencies of some 20 kc/s are of greater value. One limitation, however, is that at energy concentrations appreciably higher than 1 w/cm^2, metal particles begin to appear in suspension, no doubt due to erosion of the plating by cavitation.

The ultrasonic waves appear to influence the plating mechanism in ways more fundamental than can be explained merely by agitation. As might be expected, anode polarization and cathode starvation are eliminated, and plating speeds of many times the present ones appear practicable—i.e. assuming the pretreatment stages could be accelerated to a similar degree. The distribution of the coating is also improved—rather surprisingly, since very poor throw might well be anticipated with such high currents—while the coatings themselves appear to be affected. These can be produced in purer form, yet with higher tensile strength and hardness, and with a smaller crystal size. It is believed that the main reason for earlier disappointments lay in the use of excessively high frequencies. More recent work has utilized frequencies of 20 to 40 kc/s, and one worker has stated that he would go lower still, except that the noise is unbearable.

In nickel plating, one of the chief advantages had been that the temperature need no longer be maintained accurately, while an increase of from two to five times the current density could be tolerated without burning; some claims even go up to 30 times! Adhesion is materially improved—a feature of its application to all plating processes, no doubt because residual traces of grease are displaced by the shock waves. While this has obvious advantages, one drawback in bright nickel electrolytes, which are very sensitive to organic contamination, might be that less attention is applied to cleaning. A disappointment in this respect, incidentally, is that passive and oxide films on reactive metals such as aluminium and stainless steel are not displaced in a manner analogous to their removal with the ultrasonic soldering iron; such metals still require the usual etch pretreatments.

Bright nickel addition agents have been found to break down under the influence of this agitation if of high molecular weight; in the U.S.A., however, more stable short-chain additives have been evolved. However, several claims have been made for the production of bright deposits from dull-plating solutions, presumably largely due to refinement of the crystal structure. Used in conjunction with a levelling agent, this could well lead to simpler bright nickel solutions, while the information that low frequency agitation improves the throwing power, owing to the cavitation effect preventing concentration gradients within the electrolytes, gives further promise of improved deposits.

In chromium plating the application of ultrasonics has had a dual objective, one to increase the permissible current densities in hard chrome plating to very high values, and the other actually to improve the throwing power. In the first respect, current densities well over 2,000 amp/ft^2, and far in excess of those attainable with air agitation, have been achieved without burning: whether this is a practicable achievement is debatable, of course. Improvements in throwing power and plate distribution have not materialized, although it appears that covering power is improved, a factor of real interest in decorative plating. The agitation has also proved its worth in barrel zinc plating, where it is claimed not only to speed up the process by 200 per cent, but also to improve the contact between the tumbling work and to take care of inadequately pretreated items. Again, in cyanide silver plating, notorious until recently for the very low permissible current densities, currents of up to 140 amp/ft^2 have been successfully used. Here it has been found that the plate actually deteriorates in adhesion if high currents are not used. This finding has obvious value in heavy silver plating, e.g. of bearings and chemical plant. These results, while far from comprehensive, do unequivocally indicate that we can expect to use this energy source quite extensively in the plating shops of the future.

Fig. 10—Ultrasonic cleaning plant for cold rolled steel strip [Courtesy Roto-Finish Ltd.

Miscellaneous Uses

Pickling operations offer another fruitful field for exploration. The mechanisms involved are the same as in cleaning, but using this agitation it is either found that the job can be greatly accelerated, or else that a much milder pickle can be used. One successful application has been for the removal of carburizing scale from gearwheels. An inhibited hydrochloric acid solution, agitated by sound at 25 kc/s, was found to achieve a higher standard of cleanliness in 90 sec., a fifth of the time necessary without the agitation. Smut, a considerable bugbear in pickling, presents no difficulty, since it no longer adheres when subjected to the sound waves. In another case, the highly corrosive acid mixture needed to pickle Monel metal typewriter dies was replaced with a sound-agitated 5 per cent solution of citric acid, with obvious advantages plus an increase in speed.

Some quite spectacular, though largely unconfirmed, reports have appeared of its successful application to anodizing. In the sulphuric acid process, these chiefly relate to higher current densities for a given temperature, with improved film properties. Agitated dye baths are said to enable the dyeing operation to be cut down to seconds, with a reduction in dye concentration as well. In chemical nickel plating, however, it causes rapid decomposition of the solution.

After subjecting metal parts being sprayed with metal to ultrasonic agitation, the coatings have been found more homogeneous, while another suggested application is for the pre-ageing of polishing compounds while the melt is cooling. This would avoid the present deterioration during storage. Also, there is the prospect of an ultrasonic adhesion tester for plated, and possibly other, coatings. This, unfortunately, appears limited to detecting coatings of negligible adhesion, however.

Lastly, one of the most successful applications has been for the agitation of small tinning pots, by means of which aluminium electrical components can be rapidly dip-tinned and subsequently soldered without special fluxes or technique to displace the oxide film.

Non-Ferrous Tubes in the Stress of Modern Conditions

By C. BRECKON, B.Sc., F.I.M., A.R.I.C. and P. T. GILBERT, Ph.D., F.I.M., F.R.I.C.

(*Concluded from* METAL INDUSTRY, 1 *August*, 1958)

ONE obvious way in which stresses introduced during assembly can give trouble is when brass pipes that have been cold bent or otherwise cold worked are put into service without being given a stress relieving heat-treatment. Heat-treatment after cold working is good practice for all copper alloys, but in the case of brasses it is particularly necessary, and trouble is very probable if it is omitted. An example of an application where failure to heat-treat would be likely to lead to failure in service is in the installation of aluminium brass cargo heating coils in oil tankers. The complicated network of pipes in the bottom of each tank is usually fabricated by cold bending.

Even if stress relieving after bending is satisfactorily carried out, dangerous assembly stresses can still be introduced if pipes are misaligned or are forced into positions into which they do not quite fit. These points need careful attention if trouble is to be avoided.

There are circumstances in which assembly stresses can lead to stress corrosion of straight tubes in heat exchangers. Consider, for instance, the tubing of a bundle in which the tubes are to be expanded at both ends. As tubes are rolled into a tubeplate, each hole tends to be slightly enlarged, and stresses are imposed which cause the tubeplate to bulge outwards with the maximum displacement, of course, at the centre. This effect is most noticeable with the larger diameter plates. It is sometimes the practice when tubing a condenser to install four or more small groups, each of a dozen or so tubes, at widely spaced points to "hold the tubeplates." When rolling-in is completed, it can readily be seen that the initial small groups of tubes are likely to be under greater longitudinal tensile stress than the other tubes, since in their case the movement of the tubeplate in relation to the initial tube length will be at a maximum. Cases are known in which failures by circumferential cracking immediately behind the tubeplate have been confined to groups of tubes installed as described above.

The correct procedure, which is particularly important with large tubeplates, is to expand all the tubes in at one end first (in any order) and then at the other end to expand first the tubes all round the periphery, moving inwards one row at a time and finishing at the centre. In this way, the stress in any tube in the completed bundle should be negligible.

As well as the pattern of rolling-in, the actual expansion operation itself is important. Rolling equipment manufacturers have studied this problem and have adopted different methods of obtaining the best possible result. To ensure satisfactory service, the stresses introduced must be kept to a minimum, and as far as possible they must be evenly distributed amongst all the tubes. The desired result can be obtained if properly designed rolling equipment is used. For instance, it is recommended that normally the tube should be expanded over about 80 per cent of the thickness of the tubeplate. "Over-rolling" or cold working of the tube behind the tubeplate, due to rolling over a greater distance than the thickness of the tubeplate can lead to stress corrosion failures.

Service Stresses

There are obviously many ways in which tubes may have stresses imposed on them in service. In some cases it is known that the tubes will have to withstand service stresses, and the magnitude of these stresses may be capable of accurate calculation. For instance, there may be a fluid or a gas inside the tube at a known pressure and temperature. Less commonly, there may be a greater pressure outside the tube than inside. The pressure is often fixed, but the temperature is rather less definite in cases where heat exchange is going on, since the fluid inside the tube is then at a different temperature from that outside, with both these temperatures changing as the fluid flows along the tube. Even when the pressure is nominally fixed, it is not unusual to find pressure fluctuations which are not allowed for in the calculations, and momentary high pressure surges are also a source of trouble that is often overlooked.

Knowing the internal pressure in a tube, it is possible to calculate the hoop stress by means of one of the three formulae following:—

$$\text{Pressure} = \frac{2 \times \text{hoop stress} \times \text{wall thickness}}{\text{bore}} \quad \text{......(1)}$$

$$\text{Pressure} = \frac{2 \times \text{hoop stress} \times \text{wall thickness}}{\text{bore} + \text{wall thickness}} \quad \text{......(2)}$$

$$\text{Pressure} = \text{hoop stress} \times \frac{D^2 - d^2}{D^2 + d^2} \quad \text{......(3)}$$

where D = outside diameter
d = inside diameter.

TABLE I—HOOP STRESSES

Thickness of 1 in. bore tube	Hoop Stress (lb/in².)		
	Formula 1	Formula 2	Formula 3
0·050	10,000	10,500	10,526
0·100	5,000	5,500	5,555
0·150	3,333	3,840	3,906
0·500	1,000	1,500	1,666

The accuracy of these formulae increases as their complexity increases, and the differences in the results obtained are shown by the example given in Table I, which gives hoop stresses for an internal pressure of 1,000 lb/in^2.

For most purposes, Formula 2 is sufficiently accurate.

It is then possible to check whether the calculated hoop stress is permissible in tubes of a given alloy at the given operating temperature by reference to tables of data based on experimental results, such as those given in the Tubular Heat Exchanger Manufacturers' Association Manual.[12] More commonly, the formulae quoted above are used to find the minimum wall thickness necessary in tubes of a given diameter in order that the hoop stress shall not exceed the maximum working stress recommended for the alloy in question. If, by any chance, excessive internal pressures are applied, failures will occur, of course, by the development of longitudinal splits.

Unintentional stresses of unknown magnitude may often be applied to tubes in service, and if these are sufficiently high any tube is liable to fail. It is usually impossible to eliminate all such stresses, and in order to minimize the effects of those that remain it is useful to bear in mind the following general points.

Brasses and aluminium bronzes are less resistant to stress corrosion than other copper-base alloys.

There are indications from service experience over a period of several decades that high-purity materials tend to give rather better results than materials in which relatively high impurity contents occur. For instance, lead is an undesirable impurity in brass condenser or heat exchanger tubes, and in aluminium brass tubes the tin should also be closely controlled. Indeed, manufacturers of the highest

Fig. 4—Photomicrograph of brass tube showing intercrystalline cracking by stress-corrosion. ×200

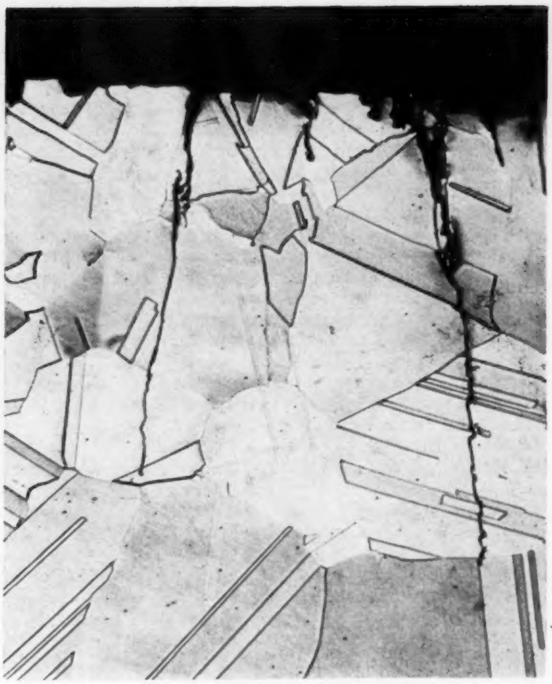


Fig. 6—Transcrystalline cracking by corrosion-fatigue. ×125

quality products control the composition of their materials to considerably closer limits than those laid down in any of the published specifications.

Again, as a result of service performances over a wide field and a long

Fig. 5—Cracking due to corrosion fatigue, exhibiting cracks in close proximity. ×15

period, it is considered that the best results are obtained with tubes of temper as uniform as possible. For instance, in the case of tubes to be expanded at both ends it was formerly the practice to use hard tubes with the ends locally annealed for a short distance. While such tubes are satisfactory under many conditions, there is no doubt that in some circumstances they are liable to fail by circumferential cracking in the soft area immediately behind the tubeplate. This has been recognized in specifications such as B.S.1464 and A.S.T.M. B.111. Even for applications not covered by these specifications it is becoming increasingly common for manufacturers to supply tubes of even temper throughout, and of such a hardness that the ends can be expanded or rolled into the tubeplates without further local heat-treatment. If stress is imposed on such a tube during service, the strain is equally distributed throughout the length of the tube. With a substantially hard tube having a relatively soft portion at each end, on the other hand, the limit of proportionality for the soft portion may be exceeded and the liability to cracking is, therefore, greater.

Stress corrosion cracks in copper-base alloys may be either intercrystalline or transcrystalline, though the former are more common. An example is shown in Fig. 4. When stress corrosion is the cause of failure it is usual to find that although there may be some general surface corrosion, and even a number of small subsidiary cracks, one crack far outstrips the remainder. This is because the effects of the stress concentration at the bottom of the deepest crack are such that penetration normally continues to proceed most rapidly at this point.

Corrosion Fatigue

Failures of tubes in service are sometimes due to the combined effects of alternating stresses and exposure to a corrosive environment, i.e. to corrosion fatigue.[13] The most usual sources of alternating stresses are vibration and expansion and contraction effects, due to repeated temperature changes. Heat exchangers are frequently situated near to heavy machinery, turbines, diesel engines, pumps, etc., and it is obvious that heat exchanger tubes are liable to be subjected to alternating stresses from both of the sources mentioned above.

Corrosion fatigue fractures in copper-base alloys are almost invariably transcrystalline, though it is possible that in special circumstances the cracks could be intercrystalline, e.g. with brass tubes in contact with ammonia. This affords an interesting comparison with stress corrosion cracking. Thus, the occurrence of intercrystalline cracks in copper alloy tubes is usually indicative of stress corrosion, while transcrystalline fractures may be a result of either stress corrosion or corrosion fatigue. In the case of corrosion fatigue there are usually several cracks in close proximity to each other, many of which have progressed to approximately the same extent.. Some of these features are illustrated in Figs. 5 and 6.

Frequently, however, it is difficult to

distinguish between the phenomena of stress corrosion and corrosion fatigue, since failures often bear some of the characteristics of both. This is perhaps not altogether surprising, since there must be many cases when both steady tensile stresses and alternating stresses are imposed on the tubes simultaneously.

For maximum resistance to corrosion fatigue, as well as stress corrosion, it is considered important both that the tube alloy should be of the highest quality and that the tube should, as far as possible, be of uniform temper throughout, as discussed earlier. In general, however, if the alternating stresses are excessive, failures are liable to occur even in the best tubes, and in this case steps need to be taken to reduce the level of the stresses by eliminating or damping down vibration, making provision for expansion and contraction, etc.

The fatigue limit for most materials is considerably reduced even if the environment present when alternating stresses are imposed is only mildly corrosive. It is, therefore, likely that a much greater improvement in service performance will be obtained if the stresses can be reduced or eliminated, than if the corrosiveness of the environment is reduced, though the latter may also be helpful. Furthermore, the reduction in fatigue limit due to the effects of corrosion is similar for most of the copper-base alloys, and no great improvement can be expected by use of alternative alloys in the case of corrosion fatigue failures. This is in contrast to the case of stress corrosion failures, when considerable advantage may be gained by changing, for example, from a brass to a cupro-nickel.

An attempt has been made to link together in this Paper some of the things which happen to non-ferrous tubes, using stress as the connecting thread. This is, perhaps, an unusual choice, and in some ways the main justification for its use is that although many Papers have been published over the years on the various aspects of manufacture and service behaviour of non-ferrous tubes, so far as the authors are aware, the subject has not been treated in this way before. It would not be right to draw this article to a close without making some attempt to put service failures into their proper perspective. It would, indeed, be unfortunate if what has been said gave the impression that service failures by the various methods of attack outlined were commonplace and usual, for such is not the case.

References to a number of important Papers are attached, and study of these will give an indication of the ways that this branch of industry has overcome some of the problems with which it has been faced. To take the outstanding example, the life of condenser tubes forty years ago was a matter of considerable uncertainty, and premature failures due to dezincification, impingement attack, season cracking, etc., were the order of the day.[14-21] The period from about 1927 to 1937 was one during which greater progress was made than before or since. During this time came the adoption of arsenic inhibition of single-phase brasses,[21] the discovery of aluminium brass,[22] the development of cupro-nickel alloys, including the addition of iron and manganese to the 70:30 alloy, and the discovery that the addition of higher amounts of iron and manganese gave a material very resistant to abrasion and erosion.[23]

Failures due to stresses, other than the season cracking type of failure, rarely caused trouble in the early days because, on the one hand, tubes were likely to fail from some other cause before they failed due to stress, while on the other hand it was almost universally the practice for tubes to be ferruled at both ends so that individual tubes could move in their glands without giving rise to conditions of stress. The improvement in metallurgical techniques and alloys, eliminating many of the earlier causes of premature failure, the use of erection techniques whereby tubes are fixed into tubeplates at both ends, the use of higher velocities on both water and product side, all mean that failures due to stresses of some sort will probably continue to form an increasing proportion of the greatly reduced number of failures in service. The solution to these problems requires a combined effort in which the tube maker offers tubes in the best-known alloy in the best possible condition, and the plant builder designs equipment to avoid the dangers of stresses. Stresses arising from differential expansion must be minimized, and the danger of vibration must also be minimized by ensuring, for example, that the natural resonant frequency of the portion of the tube between support plates does not coincide with the normal frequency of the turbine or some nearby plant. Again, if steam velocities are sufficiently high to cause "steam plucking," giving rise to vibrations, then extra supports must be included, and so on. Finally, care needs to be taken in the normal process of installation to ensure that these operations are carried out in the best possible manner, and the plant then needs to be operated intelligently and maintained in good condition.

Acknowledgments

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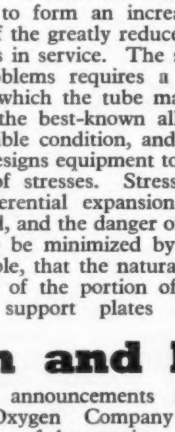
References

12 "Standards of Tubular Exchanger Manufacturers' Association, 3rd Edition, 1952, T.E.M.A. Inc., New York.
13 P. T. Gilbert; *Metallurgical Reviews*, 1956, **1**, 379.
14 G. D. Bengough; *J. Inst. Metals*, 1911, **5**, 28.
15 G. D. Bengough and R. M. Jones; *J. Inst. Metals*, 1913, **10**, 13.
16 H. J. Oram; *J. Inst. Metals*, 1914, **11**, 38.
17 H. E. Gibbs, R. H. Smith and G. D. Bengough; *J. Inst. Metals*, 1916, **15**, 37.
18 G. D. Bengough and O. F. Hudson; *J. Inst. Metals*, 1919, **21**, 167.
19 G. D. Bengough, R. M. Jones and R. Pirret; *J. Inst. Metals*, 1920, **23**, 65.
20 G. D. Bengough, R. May and R. Pirret; *Trans. N.E. Coast Inst. Eng. Ship.*, 1923, **40**, 23.
21 G. D. Bengough and R. May; *J. Inst. Metals*, 1924, **32**, 81.
22 R. May; *J. Inst. Metals*, 1928, **40**, 141.
23 R. May; *Trans. I. Mar. E.*, 1937, **48**, 171.

Men and Metals

Recent announcements from the British Oxygen Company Limited include that of the appointment of **Mr. R. J. Barritt** as chief executive, engineering division of the company. Mr. Barritt will take up his position on September 1 next.

The appointment has been announced of **Mr. H. L. Lloyd,** O.B.E., M.C., B.A., as general manager of



the Roballo Engineering Company Limited, a new English company with offices at Dover Street, London. Mr. Lloyd was previously with the Ministry of Supply.

It has been announced by the Minnesota Mining and Manufacturing Company Limited that **Mr. L. W. Smith** has been appointed sales supervisor for the South Midland Region of the Abrasives Division of the company. Mr. Smith joined the company in 1954, after having served with leading machine tool manufacturers in this country.

At the end of last month, **Mr. E. R. Blane** relinquished his position as consultant in the technical services laboratory of Mobil Oil Company Limited on his retirement from active business life. Mr. Blane joined the company in 1934, and has had wide experience as an industrial chemist. He is an Associate of the Royal Institute of Chemistry and a Fellow of the Institute of Petroleum.

Foundry Briefs

Corrosion in Aluminium Bronze

Problems confronting the non-ferrous founder are not always those due to foundry practice or to foundry defects. Such is the case, reported here, of the corrosion of an aluminium bronze chain link casting, which failed in service due to severe local corrosion. This corrosion was partly due to galvanic action caused by the use of a cotter pin of stainless steel and partly to fretting corrosion. The use of an alloy of lower aluminium content but containing nickel, it is suggested, would offer greater resistance to corrosion.

By COUNSEL

SEVERE local corrosion of an aluminium bronze chain link casting, which led to its withdrawal from service and the subsequent investigation reported here, is a little removed from the usual range of foundry problems. However, although the primary cause of the trouble was not directly related to foundry practice, one of the recommendations for its correction was concerned with the aluminium content of the alloy.

As received by the laboratory carrying out the investigation, the chain link was as shown in Fig. 1, and the area of severe corrosive attack is clearly apparent. Alongside can be seen a typical connecting pin and retaining cotter of the kind employed with the casting. The pin was reported to be of Monel metal, whilst the cotter was of stainless steel. The pin and cotter submitted had not been in use, but the fragment of cotter pin remaining in the casting showed by inspection that it had been severely attacked, in addition to the area of casting surrounding it.

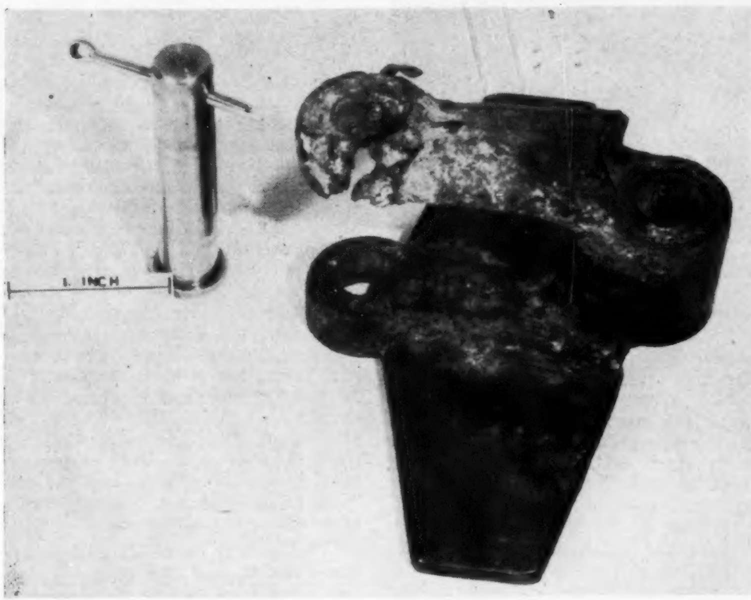


Fig. 1—Casting showing corrosion defects, and associated link components

After one of the limbs was broken from the casting, the fracture showed that corrosion had proceeded to a uniform depth over the entire cast surface. The fractured section (Fig. 2) shows the dark discoloured rim at the perimeter, indicating the depth to which corrosion had penetrated.

Several microspecimens were prepared from the badly corroded areas of the casting. A general observation at a low magnification revealed a marked difference in structure from the cast surface to the central areas. Whilst the centre of the casting exhibited a normal duplex alpha plus beta structure, the surface rim consisted only of alpha solid solution. The aluminium-rich phase had, therefore, been preferentially attacked, but a thin layer of copper at the extreme surface showed that in the latter stages the alpha solid solution had also been attacked. Fig. 3 shows a typical example of the structure just described.

Analysis showed the constituents of the alloy to be (per cent): tin, trace; lead, nil; copper, 90·15; iron, 0·19; aluminium, 9·5; manganese, nil; nickel, 0·01; zinc, 0·1; phosphorus, 0·02; sulphur, trace.

Surface corrosion had occurred throughout the casting, as implied by the evidence of the de-aluminification

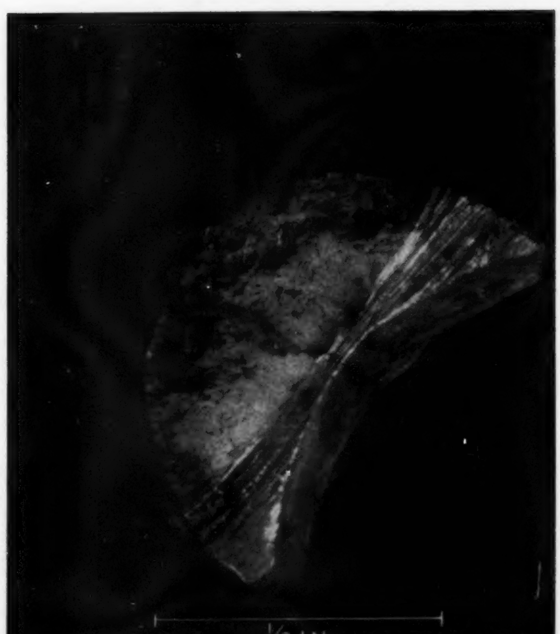


Fig. 2—Fractured section showing depth of general surface corrosion

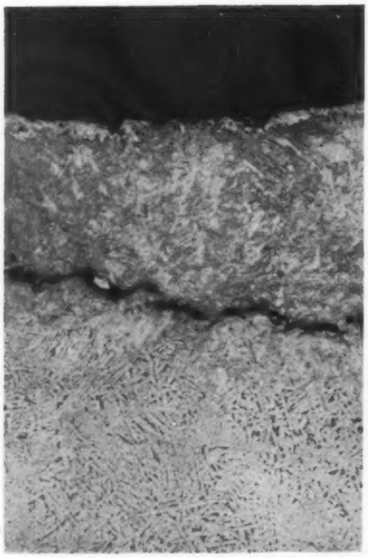


Fig. 3—Microstructure at cast surface showing rim of α phase and thin layer of copper. Central areas of normal α + β structure

effect. This, however, had taken place far more severely in the bushed section which contained the split retaining pin. The reason for this would almost certainly be due to the use of a stainless steel component which had resulted in a galvanic action under service conditions. In addition, however, due to the freedom with which the pin and cotter can be mechanically disturbed, "fretting corrosion" is thought to have occurred. The mechanics of this "fretting" effect are continually to remove protective oxide layers as they are formed on the contact areas. In the "Corrosion Handbook," published by Chapman and Hall, 1948, Uhlig states that the combination of stainless steel upon itself or with any other metal is very susceptible to fretting attack under corrosive conditions. Nickel, however, is one of the metals least susceptible to this type of attack. This indicates, therefore, that the use of a Monel cotter pin would considerably reduce the severity of localized corrosion. It was particularly noted that the casting in contact with the flanged end of the Monel link pin had not been attacked beyond the extent to which the entire casting had been.

In drawing up further recommendations, attention was drawn to the de-aluminification of the entire surface of the casting. This general corrosion which had occurred would suggest that under the particular conditions of service encountered, an alloy of duplex alpha plus beta structure might not be entirely suitable. This was no reflection, however, on the casting submitted since analysis showed it to be of excellent quality. It might have been preferable, however, in this case to employ an aluminium bronze which contains no more than 7 per cent aluminium to exclude the formation of the beta constituent. Such alloys contain, in addition, from 2 to 4 per cent of nickel to further enhance corrosion resistance.

[*This note is based on an investigation carried out for one of their customers by Foundry Services Ltd.*]

Tube Cleaning Developments

INCORPORATING a pressure/vacuum system for abrasive feed and recovery with a thorough segregation of grit, slag and dust, a Vacu-Blast machine lends itself to adaptation for tube cleaning.

In effect, the tube is used to replace the Vacu-Blast gun with the pressure and vacuum hoses connected at opposite ends, the closed circuit being maintained within the tube body. According to the varying sizes of tube, different methods are employed. With tubes of ⅛ in. bore, the blow-through method is used, but the cross-sectional area of the subject items must be greater than the area of the blast nozzle. Usually a nozzle of 5/16 in. bore is used and, to conform with the above stated requirements, tubes of ⅛ in. bore are nested to give a cross-sectional area upwards of 0·077 in^2 or seven ⅛ in. bore tubes. A simple adaptor is made to nest these tubes and the Vacu-Blast nozzle is offered to this adaptor, which acts as a distribution box for the abrasive. In this manner, back pressure is avoided and the blast stream continues throughout the length of each tube.

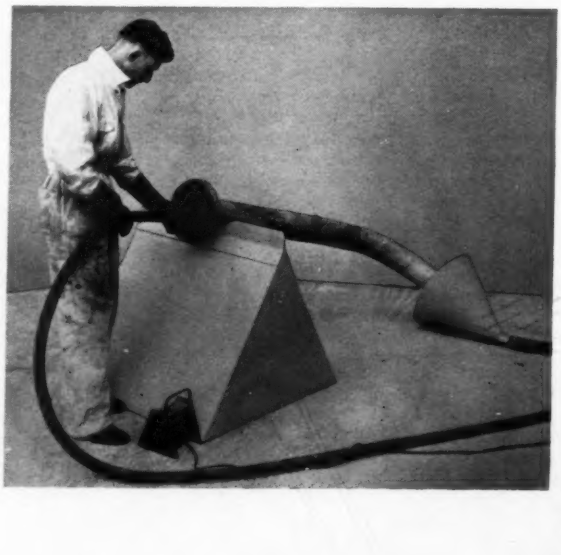
Tubes in the range of bore sizes ½ in. to 2 in. may also be cleaned on the blow-through principle, but the nozzle is now offered direct to the mouth of the tube. Above this size, the nozzle can be entered into the tube and traversed right along the work surface. The usual method is to pass the nozzle to the far end of the tube and then switch on the blast stream by means of a foot switch, withdrawing the nozzle slowly whilst blasting is in progress.

Larger bore tubes in the approximate range 3 in. to 8 in. are cleaned in a similar manner, but owing to the greater surface area involved it may be necessary to select one of three different attachments to clean certain parts. Amongst these attachments it is most probable that the supersonic nozzle or parallel bore nozzle will clean 80 or 90 per cent of the surface area, but the odd 10 per cent will necessitate use of the angle nozzle. This nozzle directs abrasive at 90° to the longitudinal axis of the blast hose, thereby securing impingement of the abrasive normal to the work surface. Such treatment is frequently necessary at the inner bend of tubes which have been packed with sand and heated prior to forming.

Tubes above 8 in. bore are cleaned in a similar manner but, to facilitate passage of the blast hose, it may be advisable to introduce a spider attachment to centralize the nozzle in the tube.

Cleaning speed varies quite considerably according to the nature and condition of the tube to be cleaned, but in all cases the cleaning rate has proved to be surprisingly fast. A heat-treated alloy steel tube bearing an exceedingly tenacious heat scale was cleaned thoroughly at a rate amounting to 40 ft^2/hr., whilst ordinary commercial mild steel piping might be cleaned at rates as high as 250 ft^2/hr. The cost of cleaning varies *pro rata* to the cleaning speed.

For cleaning large bore straight tubes in the range 10 in. to 24 in., the rotary head, comprising two rotating blast nozzles, driven by an air motor, has been developed. The assembly is mounted on a carriage and is drawn through the tube while blasting is in progress.



Tube cleaning with the pressure/vacuum system developed by Vacu-Blast Limited, showing the cone used for recovery of grit from the return end of the tube

Industrial News Home and Overseas

Copper Price

To avoid misunderstanding, it is pointed out that the issue of METAL INDUSTRY for July 18 last containing our usual Price Changes chart included an error in the price of copper for Wednesday, July 16. This showed the price of copper for that day as being £215, whereas this should obviously have read £200 15s. 0d. The error was caused by a misunderstood telephone transcription.

Sole Agency

We are informed by **Fleischmann (London) Limited** that they are the sole authorized agents and distributors for the United Kingdom of all quartz products manufactured by Heraeus Quarzschmelze G.m.b.H., of Hanau, Western Germany, with the exception of optical quartz.

A New Factory

At the annual general meeting of **Firth Cleveland Ltd.**, the chairman announced that a new factory for the Firth Company Limited, of Warrington, built to replace the one destroyed by fire in December last year, will be brought into production as from September 1 next, when the ground floor will be ready for occupation.

The new building is a reinforced concrete structure, designed by Mr. Charles McIntosh, the architect, in co-operation with the design department of Richard Hill Ltd., who also supplied the reinforcement used on the contract. Special acid-resistant paint and lead for the windows was supplied by British Lead Mills Ltd.

Storing Welding Rods

A problem which involved the storage of welding rods at the Edmonton factory of **British Oxygen Gases Ltd.** (Equipment Division) has been solved, it is stated, by the use of echelon stacking. Using Dexion slotted angle, racks have been arranged in diamond formation which affords faster handling of materials and a reduction in the maintenance costs of fork lift trucks. The racks have a guaranteed safe load of 10 tons/yd^2, but each is used to support only five tons of equipment.

Clean Air Act

A new handbook on the provisions of the Clean Air Act which came into full operation on June 1 last, has just been published by the **Federation of British Industries,** entitled "A Guide for Industry to the Clean Air Act 1956." This edition brings up to date the Federation's previous publication on this subject and includes the regulations which the Minister was empowered to make under the Act.

An Export Order

A 64,000 amp rectifier plant for applying electrolytically a thin coating of zinc to steel sheets is shortly to be installed in the Sollac Steelworks in Eastern France, including oil-less water-cooled Westinghouse selenium rectifiers controlled by transductors. **Westinghouse Brake and Signal Co. Ltd.** are the main contractors for the rectifier equipment, which has been manufactured entirely in France by their associates—Compagnie des Freins et Signaux Westinghouse.

Autumn Trade Fair

For the third year in succession, the **Birmingham Engineering Centre** is exhibiting at the Vienna Fair, to be held from September 7 to 14 next. By arrangement with the Board of Trade, the Centre's stand in the British Pavilion will handle all engineering enquiries received on the adjacent official B.O.T. display. The Engineering Centre will set up an "information bureau" on British engineering, and will distribute literature and answer enquiries. The stand will also display a limited number of products.

Aluminium in Hungary

A three-year programme of expansion of the aluminium industry now under way in Hungary includes considerable development of extraction of valuable by-products. An experimental plant is now being built at Ajka, western Hungary, for the manufacture of 15 kilograms of gallium a year. Previously, Hungary has only processed vanadium, a silvery metallic element. Gallium, one of the rare metallic elements, commands a higher price on world markets than platinum, reports the newspaper *Népszava*. At Almásfüzitö, northern Hungary, a new plant will annually extract iron oxide from up to 400,000 tons of the red mud, of which there are large deposits around alumina plants. And at Mosonmagyaróvár, western Hungary, a plant to process fluorine will begin operation in 1959. An estimated 600 tons of synthetic cryolite, one of the earliest sources of aluminium, valued at £120,000, will be manufactured from the fluorine.

More than £4 million (140 million forints) is to be spent during 1958-60 on the sinking of two new bauxite mines, which will have a combined annual output of over 500,000 tons. In three years, bauxite production is scheduled to increase by 25 per cent, making it possible for alumina factories to raise annual production to 200,000 tons by 1960—a 28 per cent increase on 1957 output.

It is planned to raise the output of Hungarian-made aluminium to 45,000 tons a year by 1960. The three-year development plan also includes expansion of the Kobánya Aluminium Foil Factory, Budapest, which is to increase its capacity by 500 tons a year. This will cut out all imports of aluminium foil and enable Hungary to become an exporter of the product. A light metal works to be built at Székesfehérvár, central Hungary, with Soviet help and which will be equipped with Soviet-made machines, will be among the most modern in Europe. It will provide 80 large factories with rolled aluminium tram and bus chassis, prefabricated aluminium elements which will speed the construction of ships and the manufacture of agricultural machinery and cables. The factory will also manufacture aluminium household goods.

Swiss Aluminium Cut

It is reported from Zurich that the Swiss concern Aluminium Industrie A.G. of Chippis, has informed the Swiss authorities that it intends to cut output of its aluminium plant at Badisch-Rheinfeld, West Germany, by 30 per cent from next September. This would mean a loss of output of about 7,000 tons annually.

This statement was made during discussions between the company and the authorities on claims made against the former by farmers in the frontier zone near the plant, that fluorine in the plant's waste gases was causing damage to crops and cattle. The firm said that by next spring it would have completed the installation of supplementary filtering equipment at the Badisch-Rheinfeld plant to retain the fluorine gas and fluorine-bearing dusts.

National Radio Show

At this forthcoming exhibition, to be held at Earl's Court, London, during the latter part of this month, the **Westinghouse Brake and Signal Co. Ltd.** will make a comprehensive display of the various types of rectifiers manufactured by the company which will be of great interest to both professional engineers and amateur enthusiasts. Copper-oxide rectifiers, with their low forward resistance and stable reverse resistance, are particularly suitable, in a bridge assembly, to operate moving coil instruments to indicate A.C. values to a high order of accuracy. In telecommunications, the non-linear characteristics of these rectifiers are utilized in modulators, demodulators and limiters, whilst their stable reverse characteristics are used as D.C. stoppers.

Selenium rectifiers will be shown in various types of assembly to illustrate the methods of cooling and chassis mounting now possible with Westinghouse rectifiers designed for radio and television H.T. supplies.

Handling Exhibition

It is now some twelve months since the material handling division of **Fisher and Ludlow Ltd.** opened its Scottish office to provide industrial firms with a local centre at which full information on material handling equipment could be obtained. So successful has this effort been, that the firm now announces that the first Fisholow Material Handling Exhibition in Scotland is to be held at the Shettleston and Tollcross Hall, in Glasgow, from September 22 to 26 next.

A wide range of equipment will be available for inspection and demonstration at this exhibition, and will include conveyors, pallets, factory equipment, flooring, and the Fisholow Cargon system. The company's film unit will also be in attendance, showing the latest films illustrating modern methods in material handling.

Change of Name

News from A.D. Tack Rags and Adhesive Dusters Ltd. is to the effect that the name of the company has now been changed to **Anti-Dust Services Ltd.** in order to embrace the wider activities of the company, as a result of the considerable developments that have taken place since its formation.

The original manufactures of the firm, tack rags and impregnated dusters, are, we understand, now supplied to most of the leading manufacturers in the United

Kingdom. The field in which the biggest developments have taken place, however, is in the elimination and control of dust in industrial processes In this large and increasingly important field, the services of one of the foremost applied research laboratories in the country are now available to those having special dust problems of a difficult nature.

The address of the company remains, as before, at Stafford Street, Dudley, Worcs.

Concrete Floor Paint

A new type of heavy duty concrete floor paint has recently been introduced by **Allweather Paints Ltd.** This "Pitacrete" paint has been specially formulated to produce a very tough coating with hard-wearing properties, to give outstanding service against heavy traffic of all kinds.

Among the characteristics claimed for this paint are: petrol splash and mineral oil resistant; weak acid and alkali resistant; quick drying (1 hr. touch dry); eliminates dust; extreme resistance to abrasion, and washable (soaps, detergents, etc.). This paint can be obtained in dark red, medium grey, and verdigris green.

Lifting Magnets

Circular lifting magnets provide a well-established means of transporting iron and steel in a variety of forms. **Rapid Magnetic Machines Ltd.** manufacture deep field circular lifting magnets of a much deeper construction than conventional design, giving up to 100 per cent greater lift, it is said, dependent on the nature of the load. For instance, a "Rapid" 46 in. diameter size will lift up to 3 ton lumps of iron-bearing slag or skull cracker balls at anything up to 9 tons weight.

The company also produces metal separating equipment for all metals.

European Titanium Company

It has been reported from Pittsburgh that the Titanium Metals Corporation of America has announced expansion of its operations to Europe by the formation, with Deutsche Edelstahlwerke, of a jointly-owned titanium company. The new company will be called Continental Titanium Metals Corporation, and will produce and market titanium metal in Europe from Luxembourg headquarters. The plant will be sited at Krefeld.

News From Birlec

Until recently, orders for Birlec standard furnaces were built by the Heating Division of **Birlec Limited,** which handled both large and small installations. But, owing to the pressure of the constantly increasing demand for these furnaces, the need has been felt for a separate division to handle solely this type of work.

The company has, therefore, organized the Standard Furnace Division, which will be under the management of Mr. John Penfold, who was formerly furnace department manager of the Morgan Crucible Co. Ltd. Already the establishment of this division has resulted in the expedition of orders, and in other ways has proved its success. Birlec standard furnaces include horizontal, vertical, and liquid bath batch type units, with shaker hearth and mesh belt furnaces for continuous work handling. These furnaces cater for hardening, tempering, annealing, nitriding, brazing, sintering, die-casting, and other processes, with appropriate atmosphere control equipment.

The Holman Group

During the last six months, the complete merging of the activities and interests within the Holman Group of the two major companies, **Holman Brothers Limited** and **Climax Rock Drill and Engineering Limited,** has been proceeding apace. By re-siting manufacturing units and centralizing administration at Camborne, Cornwall, the headquarters and centre of production, overlapping has been eliminated, and substantial economies should result both in manufacturing and office costs.

Changes are also taking place in some of the main branches of the group in the United Kingdom. The address at 44 Brook Street, W.1, London office of the Holman company, has also now become the London office of the company Climax Rock Drill and Engineering Limited. The London manager for the group is Mr. W. B. Tozer.

In Scotland, the integration has meant that new premises have had to be obtained to deal with the joint work of the two companies. The companies will, in future, have their common home at new premises which have been purchased at 20-26 Ashton Lane, Glasgow, W.2. Manager at the Scottish office will be Mr. Tom Jones, and the premises are being adapted to provide first-class sales, stores and servicing facilities.

United Nations Metals Conference

It is reported from New York that the United Nations has called an inter-governmental meeting on copper for September 8, and another for September 11, to consider problems arising in international trade in lead and zinc. Both meetings will be held in London. This was disclosed by Mr. Philippe de Seynes, Under-Secretary for Economic and Social Affairs of the U.N.

Mr. de Seynes said that the Secretary-General at the end of last year consulted the major importing and exporting countries of certain non-ferrous metals. On the basis of these soundings, it was decided to proceed with the September "exploratory" meetings, which would afford an opportunity for inter-governmental consideration as to whether further action was desirable, he said.

It is understood that the United Kingdom has accepted the invitation by the United Nations to attend the two conferences in September on copper, and on zinc and lead. The meetings are to be reviews of the general developments in international trade of those commodities and, in the light of those reviews, to decide whether any action should be taken.

Singapore Tin Shipments

Tin shipments from Singapore in July totalled 477¾ tons, compared with 716¼ tons in June and 735¼ in July last year, according to the Straits Trading Company. Of last month's total, the United States took 95 tons; Europe, 13; Japan, 233; the Pacific, 49¼; India, 25; South America, 15; Australasia, 45¼, and the Middle East 2¼ tons. Shipments from Penang during the month totalled 3,058¾ tons, against 2,355¼ in June and 4,506¼ in July last year. Of the Penang July shipments, the United States took 1,344¾ tons; Europe, 305; Canada, 125; Japan, 373½; Pacific, 4; India, 518¼; South America, 117; Africa, 14; Australasia, 27¼, and Middle East, 230 tons.

Post-Graduate Courses

It is proposed by the Department of Metallurgy, Birmingham College of Technology, to offer two post-graduate courses during the autumn term, commencing in October next, as follows:—(1) the metallurgy of nuclear power materials and (2) spectrographic and chemico-physical analytical techniques for metallic materials.

The course on nuclear power materials is intended for technical staff engaged in research and development on nuclear reactors, and for students proceeding to advanced metallurgy examinations. Ten lectures will be given on successive Tuesday evenings, commencing on October 7, 1958. Extraction, fabrication and physical properties of the fissile metals, and of those non-fissile metals of special interest in reactor technology, will be dealt with, together with the effects of radiation. The development of fuel elements and canning materials will be reviewed, as will the metallurgy of reactor structural work.

The course on spectrographic and chemico-physical analytical techniques for metallic materials is intended for metallurgists and chemists engaged in research and development work. Subjects to be dealt with include spectroscopy and its application to both ferrous and non-ferrous alloys, polarography, absorptiometry, and the established electro-chemical methods. The course will consist of 12 lectures, held on successive Wednesday evenings, commencing on October 8, 1958.

The lectures will be illustrated by optical aids, together with laboratory equipment. The meetings will comprise a lecture, with demonstrations and discussions. Full details of each programme, and application forms, can be obtained from the Department. The fee for each course will be £2 2s. 0d.

Pneumatic Tools

Air tools for metal treatment and finishing are assuming increasing importance in the engineering industry, and in particular that of shipbuilding and ship repairs and maintenance. **B. O. Morris Limited,** makers of the "Morrisflex" polishing shop equipment and flexible shaft machines, are already well known for their own air tools. They have, however, extended their range by becoming sole agents for the United Kingdom and the Sterling Area for the Grasso range of pneumatic tools which are manufactured by the internationally famous Dutch company.

An illustrated folder shows the extent of the Grasso range which will be handled by B. O. Morris, and which are available to British industry through their agency. Copies of this folder may be obtained on application to the company.

Handling Equipment on Show

Main reason for the "open day" held recently at the Harlow factory of **Sunvic Controls Ltd.** was to show guests the first completed units for the data handling system being supplied by Sunvic for the U.K.A.E.A. uranium diffusion plant at Capenhurst. This will be, it is said, the largest data handling system in Europe, consisting of eight units and two mobile printers, plus control room equipment.

It will continuously and automatically scan more than 2,000 points at which are measured the temperatures of the uranium hexafluoride, glands, pump motor bearings, cooling water temperatures, as well as motor currents and voltages.

Complexity of the equipment can be judged from the fact that each unit contains more than 3,000 interconnections, over 450 relays, and several miles of wiring. Over six miles of cable will connect the equipment to the plant. Visitors were also able to see assembly and testing of Sunvic electronic instruments such as pulse height analysers and strip chart recorders, assembly and test of thermal components, and to visit the newly-opened training school. The Sunvic mobile exhibition caravan was available for demonstration of pneumatic process control equipment.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 17,748 tons, comprising London 6,262; Liverpool 10,021; and Hull 1,465 tons. Copper stocks totalled 12,457 tons and comprised London 6,324; Liverpool 5,858; Birmingham 75; Manchester 50; and Swansea 150 tons.

BICC Appointments

Various board and management changes have been announced by **British Insulated Callender's Construction Co. Ltd.,** as follows:— Mr. G. H. Walton, joint general manager with Mr. O. J. Crompton since 1956 relinquishes his executive duties on reaching retirement age. He continues to be available for consultation and for special duties as may be required. He remains on the board of the company and also of British Insulated Callender's (Submarine Cables) Ltd., Painter Bros. Ltd., and Engineering Projects Ltd.

Mr. O. J. Crompton, M.Eng., M.I.E.E., has been appointed general manager of the company. Mr. G. A. Rendle, B.Sc., M.I.E.E., has been appointed deputy general manager and continues to act as manager of the Power Cable and Telecommunication Cable Contracts Departments. Mr. E. T. Q. Davies has been appointed director and continues to act as manager of the Overhead Line Contracts Department.

The company also announces the retirement from the Board of Mr. F. B. Kitchin, M.I.E.(Aust.), which took place at the end of June last. Mr. Kitchin also relinquished his directorship of British Insulated Callender's Cables (Australia) Pty. Ltd.

Atoms for Peace

Three hundred and fifty exhibitors from thirteen countries will participate in the 2nd International Exhibition of the Peaceful Uses of Atomic Energy which is to be held at Geneva from September 1 to 14 next. At this exhibition will be seen the largest and most important display of industrial and commercial applications of atomic energy yet held anywhere.

Fellowship Awards

Awards of three Fellowships for postgraduate research have just been announced by British Oxygen Limited. The awards have been made to Mr. P. G. Clay, B.Sc., of King's College, Newcastle upon Tyne, for research in the Department of Chemistry at the College; Mr. R. E. Raab, B.Sc., of the University of Natal and the University of Oxford, for research work in the Physical Chemistry Laboratory at Oxford, and Mr. G. Saville, B.A., of the University of Oxford, for work in the Inorganic Chemistry Laboratory at Oxford.

Renewal of Fellowship for a third year has been granted to Mr. N. G. Parsonage, B.A., for work in the Inorganic Chemistry Laboratory at Oxford University.

French Aluminium Output

Output of aluminium in metropolitan France in the first half of the current year amounted to 83,178 tons compared with 78,291 tons in the comparable period of 1957. Pechiney was by far the major producer with 68,237 tons against 65,260. Output at Edea in the Cameroons amounted to 9,814 tons in the period under review against 1,856 tons in the period January-June 1957. For the whole of 1958, the Edea plant is expected to produce 45,000 tons.

A Film Display

Recent news from **The Bronx Engineering Company, Ltd.,** is to the effect that "The Adaptable Giant," a 20-minute sound film, sponsored by the company, is to be shown in the North East Coast area at the Station Hotel, Newcastle, on Tuesday, September 30, and also at the Corporation Hotel, Middlesbrough, on October 1 next.

This film illustrates a wide variety of press brake tool applications and is of great interest to all users of press brakes. Buffet and cocktails will be served and applications for tickets to attend these events should be made to Fisher Baxter and Company, 140 West George Street, Glasgow, C.2.

New Names

In future the Plastics Division of Metal and Plastic Compacts Ltd., of Birmingham, will be trading as the **Motoplas Company Ltd.,** and the Metals Division of M.P.C. will be known as **Metal and Plastic Components Ltd.**

Metal and Plastic Compacts was set up by the B.S.A. Company in 1946 to investigate powder metallurgy and manipulation and moulding in the plastics field. During the following years the two divisions—plastics and metals—diverged in their specialized applications and became, to all intents and purposes, two separate organizations. It has therefore been decided to acknowledge this by the name changes which took effect as from Friday of last week (August 1).

Greek Nickel Mine Closes

News from Athens is to the effect that the plant producing nickel-bearing iron ore at the Larymna Mine in central Greece has closed down due to lack of demand. Stocks comprising 250,000 tons of crude ore and 40,000 tons of processed material have taken up all the available storage space at the mine. Demand from the U.S. has dropped, while enquiries from Eastern Bloc countries cannot be met because of strategic embargoes.

Russia and the Tin Agreement

Leading members of the Malayan tin mining industry said this week that they could see no benefit accruing from the Soviet Union's joining the International Tin Agreement solely as an observer. The tin agreement, to which most of the world's tin producers belong, is designed to support the price of the metal by regulating production. The Soviet Union was asked to join after she had begun to unload large amounts of tin. According to London reports, however, she is willing to become an observer only.

Mr. K. J. Cumming, president of the Federated Malay States Chamber of Mines, who told reporters that he was speaking purely in a personal capacity, said that if Russia were to become an observer he could not see how producer participants in the agreement would benefit. What was wanted was a decision from Russia at the very earliest opportunity whether she was prepared to become a producer participant as requested by the International Tin Council.

Mr. Woo Ka Lim, mining member of the Federal Legislative Council and secretary of the Perak State Chinese Mining Association, said there was no provision in the constitution of the International Tin Council for observers. As an observer, Russia would get into the Council without having to hold to the production restrictions, he added.

Malayan Tin Stocks

Malayan stocks of tin metal and tin-in-concentrates at the end of June totalled 9,840 tons compared with 9,526 tons at the end of the previous month, according to official figures issued in Singapore.

Yugoslav Lead and Zinc Ore

Exploitation has begun of lead-zinc ore deposits found in the neighbourhood of Pristina at a rate of some 220 tons of ore per day. It is expected that by next year, the mine will reach an annual output rate of 240,000 tons of ore. This would have a content of some 10,000 tons of lead, over 2,000 tons of zinc, nine tons of silver and 40,000 tons of pyrites.

Engineering Appointments

It has been announced by the **Steel Company of Wales** that Mr. I. S. Scott-Maxwell, who has been unable to carry out his duties for an extended period due to illness, has now returned to full time duties as assistant general manager (Engineering and Development) of the Steel Division of the company.

At the same time the company confirms the appointment as chief engineer, of Mr. J. H. Groocock (formerly chief electrical engineer) who in the absence of Mr. Scott-Maxwell has been carrying out the duties of acting chief engineer. Mr. H. D. Morgan, who, during the same period has been acting chief electrical engineer is now appointed chief electrical engineer.

Harwell Courses

During the past nine months nearly 300 company directors and senior executives have been at the Isotope Division of the Atomic Energy Research Establishment at Harwell for three or four days to learn something of the many uses to which radioisotopes can be put and how they can reduce their costs by doing so.

These courses are designed specifically for people without any training in radioactivity, the basic principles of which are simply explained. Close contact is made with a large number of scientists of the Isotope Division at Harwell working on specific problems facing industry and a two-way traffic in ideas has developed as many company directors, prompted by what they see and hear, bring up ideas for the possible application of isotope techniques in their own businesses which had not been seriously considered before.

One further four-day course is being run this year from September 23-26 by Harwell and application forms may be obtained from the Registrar, Isotope School, A.E.R.E., Harwell, Berks. The fee for the course including full board and accommodation is £40.

Metal Market News

LAST week was a short one for trading on the Metal Exchange, as the afternoon session on Friday was cancelled in view of the Bank Holiday. Values were firm all round, but copper was outstanding, both as to volume of trading and the upward thrust of the quotation which by midweek had reached £206 for both positions, the contango, which had gradually been narrowing, finally disappearing altogether. The strength of the copper price appeared to be due partly to expectations that, the Minerals Stabilization Bill having passed through the House Committee, it would not be long before stockpiling of copper became a *fait accompli*. Moreover, there was talk of the possibility that in the States the price of copper would advance from 26½ cents to 27½ cents, which is the maximum price payable by the Government for the 150,000 tons it is proposed to take off the market during 12 months. Later in the week, optimism was further assisted by the announcement in the House of Commons that the ban on exports to Iron Curtain countries of many commodities would be lifted shortly. Details are to be given in the middle of August, but there appears to be a confident feeling that copper will be on the list of materials from which the ban will be removed. In contrast to the recent trend, stocks of copper in L.M.E. warehouses increased by 775 tons to 13,532 tons. The quotation advanced steadily throughout the week, and by Thursday afternoon had reached £208 5s. 0d. for cash and £208 10s. 0d. three months, while the Kerb market was 5s. higher. Finally, after a turnover of about 9,850 tons, which, however, does not include deals done on the kerb, the close was £210 for cash and £210 5s. 0d. for three months, these prices showing an advance of £7 5s. 0d. in cash and of £7 in three months. The pre-holiday Kerb was £211 10s. 0d. to £212 for the forward position.

It must be admitted that the copper market, in the advance it made up to the eve of the August Bank Holiday, very much exceeded all expectations, but the rise was possibly justified inasmuch as there was a certain amount of German buying to lend support. After hours last Friday, i.e. in the afternoon when there was no unofficial market to provide a quotation, news was received that the custom smelters had advanced to 27 cents from 26½ cents. As we write, although the holiday season is in full swing, the price looks like going higher, although cautious observers of the situation are inclined to think that it is time a halt was called for consolidation, if only because it would be wrong to presume that the Metals Subsidy Bill in its present form will necessarily become law. Towards the end of the week, the Belgian price was advanced to 29 francs. It will be noticed that the contango narrowed to 5s., and on Thursday of last week the midday prices for cash and three months were level at £207 15s. 0d. sellers. The July statistics when they appear are hardly likely to be so good as June; certainly there will be a decline in the total of deliveries to U.S. consumers.

Tin lost ground last week on a turnover of only 525 tons, for cash was down £3 10s. 0d. and three months closed £5 lower, the respective quotations being £731 10s. 0d. and £734. On Thursday afternoon, the quotation for cash was reported as £729 10s. 0d. to £730 10s. 0d., but it was understood that there were buyers on the Kerb at the Tin Council's support price of £730. Stocks of tin at the beginning of the week were reported 466 tons down at 17,994 tons. Both zinc and lead gave a good account of themselves, although zinc closed rather below the best level reached. After a turnover of 4,100 tons in lead, prompt gained 17s. 6d. and forward 7s. 6d., at £72 7s. 6d. and £73 5s. 0d. Zinc put on 25s. for prompt and £1 forward at £65 and £65 10s. 0d. respectively. The turnover was 5,075 tons.

Birmingham

Metal trades have been marking time for the past fortnight in the Midland area. Production will be resumed on Monday, but the influence of the holiday season will be noticeable throughout the month. The hardening of the non-ferrous metal market is regarded as a hopeful sign. One of the chief features of interest during the last few days has been the announcement that the Government intends to restrict the building of new factories in the Birmingham area. According to Major C. R. Dibben, chairman of the Regional Board for Industry, there is no question of an embargo on factory building in Birmingham. "This is merely a tightening up," he said, "of the existing policy which has been in operation for some years." Companies will have to satisfy the Board of Trade that it is essential for their economy and efficiency to have their new factory extensions in the city. The Board will be even more watchful to see that proposed extensions are not, in fact, new factories.

Movement of iron and steel from works to consumers will be on a normal scale next week. Stocks are unusually large and buying is likely to be within narrow limits until they are reduced. A good tonnage of steel is being used in the heavy electrical engineering industries, particularly those engaged on manufacture of plant for power stations. Rolling stock builders continue well employed, especially on work for foreign railway companies. Most foundries are working below capacity.

New York

Non-ferrous metals showed little feature last week. With the tension in the Middle East receding, traders were able to take a more sober look at the statistical position of the metals and the possibility of Government aid through the Minerals Stabilization Bill. Copper continued at a uniform price level of 26½ cents a lb. for both custom smelter and producer metal, with producers selling a fair amount. Custom smelters, however, sold sparsely, although enquiry picked up towards the end of the week, reflecting approval by the House Interior Committee of the Minerals Bill.

The Minerals Stabilization Bill was reported favourably by 17 votes to four. Some sources believed this enhanced the chances of approval of the legislation by the entire House, although a tough road still lies ahead. The Comex market firmed on the news of the Committee action. The House Interior Committee made minor changes in the Bill as passed by the House Sub-Committee, restoring the 3·9 cents maximum for lead and 2·9 for zinc along the lines of the Senate Bill. The copper proviso was unchanged, however.

Some metal sources speculated that if Congress passed the Mineral Stabilization Bill with the provision of Government stockpiling of 150,000 tons of copper at up to 27½ cents a lb., the domestic copper price could firm up to that level.

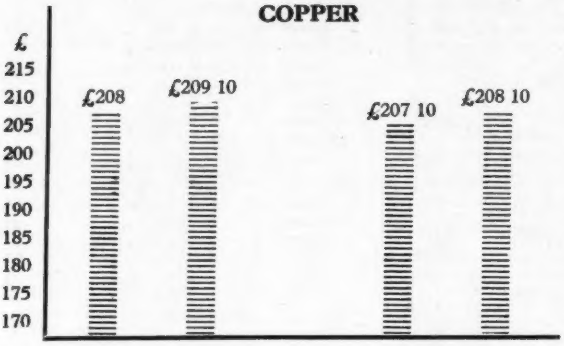
Informed sources said that producers' July shipments of refined copper were running below June deliveries, which had been boosted considerably by consumer efforts to get the metal delivered before the producer price went up. Brass mills said incoming orders were now back to the early June-late May rate, or the pace seen before the June buying rush to beat the price rise developed.

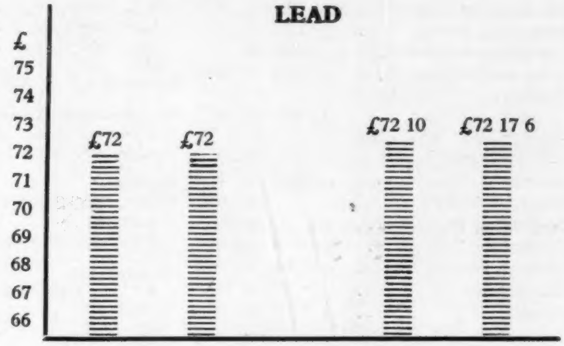
Demand for lead and zinc was spotty over the week. In lead, fair activity was reported early in the week, but the market later turned quieter. Zinc showed a brisker movement in the second half of the week. The price of lead continued at 11 cents a lb. New York, and that of Prime Western zinc at 10 cents a lb., East St. Louis.

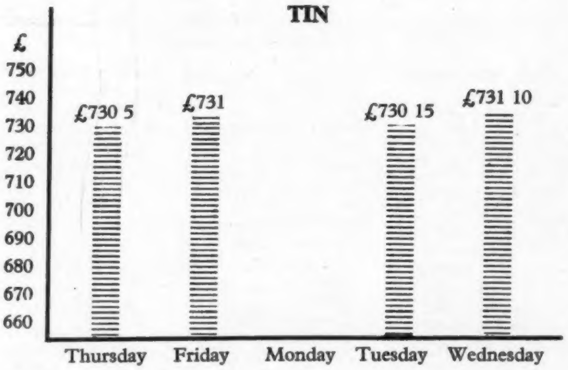
Tin was firm, reflecting the increased eight per cent retention of exports promulgated by the International Tin Council. However, prices softened late in the period as the London Market receded. The business transacted was light.

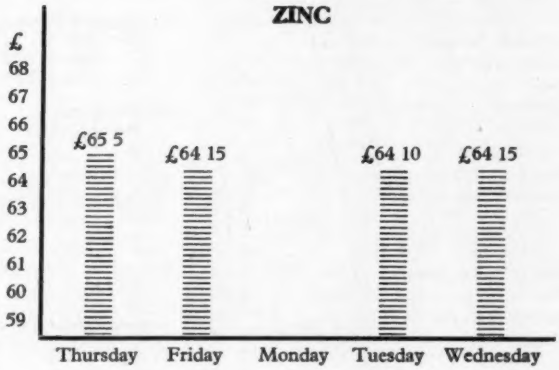
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 31 July 1958 to Wednesday 6 August 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.10	208 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,500	1,305 0					155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							390	226 5				
Electrolytic	27.50	201 0	24.00	198 5	250	217 10			2.45	192 12 6	25.00	200 0
Lead			10.75	88 15	110	95 15	179	103 17 6	.87	77 15	11.00	88 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.80	652 5	74.00	592 0
Tin	102.00	745 10 6			896	779 10	1,400	812 0	8.60	719 2 6	93.87	751 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	157	91 0 0	.82	68 10	11.25	90 0

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NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 6/8/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	208	10	0
Fire Refined 99·70%	„	207	0	0
Fire Refined 99·50%	„	206	0	0
Copper Sulphate	„	70	0	0
Germanium	grm.		—	
Gold	oz.	12	10	2
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	15	0
Magnesium Ingots	lb.		2	5¼
Notched Bar	„		2	10¼
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	79	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	23	5	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3
Tellurium	lb.		15	0
Tin	ton	731	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	64	19	4½
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	89	19	4½
Granulated 99·99+%	„	102	12	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	145	10	0
B.S. 1490 L.M.2	„	155	10	0
B.S. 1490 L.M.4	„	173	10	0
B.S. 1490 L.M.6	„	190	0	0
†Average selling prices for mid July				
***Aluminium Bronze**				
BSS 1400 AB.1	ton	212	0	0
BSS 1400 AB.2	„	228	0	0
***Brass**				
BSS 1400-B3 65/35	„	142	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	171	0	0
(86/7/5/2)	„	181	0	0
(88/10/2/1)	„	233	0	0
(88/10/2/½)	„	238	0	0
Manganese Bronze				
BSS 1400 HTB1	„	170	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„	215	0	0
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	255	0	0
Phosphor Copper				
10%	„	228	0	0
15%	„	235	0	0
**Average prices for the last week-end.*				
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	345	6	0
Grade D Plumbers	„	279	9	0
Grade M	„	378	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9	„		—	
Zinc Alloys				
Mazak III	ton	95	17	6
Mazak V	„	99	17	6
Kayem	„	105	17	6
Kayem II	„	111	17	6
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

		£	s.	d.
Aluminium				
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0¼
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10¼
Strip 10 S.W.G.	„		3	0¼
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M.				
Plate as rolled	„		2	10¼
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6¼
Sheet 18 S.W.G.	„		4	0¼
Sheet 24 S.W.G.	„		4	10¼
Strip 10 S.W.G.	„		3	9¼
Strip 18 S.W.G.	„		4	0¼
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP.				
Plate heat treated	„		3	5¼
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	9¼
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP.				
Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	7⅞
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	228	0	0
Extruded Bar	lb.		1	10⅛
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	165	0	0
Condenser Plate (Naval Brass)	„	176	0	0
Wire	lb.		2	5¼
Copper Tubes	lb.		2	0½
Sheet	ton	238	10	0
Strip	„	238	10	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	255	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	4½
Lead Pipes (London)	ton	113	15	0
Sheets (London)	„	111	10	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3¾
Wire 10%	„		3	9¾
Phosphor Bronze				
Wire	„		3	9½

Titanium (1,000 lb. lots)			
Billet over 4" dia.-18" dia.	lb.	63/-	64/-
Rod 4" dia. - ·250" dia.	„	75/-	112/-
Wire under ·250" diam. - ·036" diam.	„	146/-	222/-
Sheet 8'×2'×·250"-·010" thick	„	88/-	157/-
Strip ·048"-·003" thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	99	0	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 5/8/58.

	£
Aluminium	
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	128
Rod Ends	125
Heavy Yellow	110
Light	105
Rolled	121
Collected Scrap	105
Turnings	118
Copper	
Wire	180
Firebox, cut up	170
Heavy	168
Light	163
Cuttings	180
Turnings	160
Braziery	140

	£
Gunmetal	
Gear Wheels	168
Admiralty	168
Commercial	140
Turnings	135
Lead	
Scrap	62
Nickel	
Cuttings	—
Anodes	450
Phosphor Bronze	
Scrap	140
Turnings	135
Zinc	
Remelted	54
Cuttings	40
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):

Used copper wire	(£169.12.6)	195
Heavy copper	(£165.7.6)	190
Light copper	(£148.0.0)	170
Heavy brass	(£108.15.0)	125
Light brass	(£82.12.6)	95
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100

France (francs per kilo):

Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	(£565.10.0)	650
Aluminium	(£117.10.0)	135

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£113.2.6)	195
Lead, soft, first quality	(£84.12.6)	146
Lead, battery plates	(£49.17.6)	86
Copper, first grade	(£188.10.0)	325
Copper, second grade	(£177.0.0)	305
Bronze, first quality machinery	(£188.10.0)	325
Bronze, commercial gunmetal	(£159.10.0)	275
Brass, heavy	(£130.10.0)	225
Brass, light	(£119.0.0)	205
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

Consolidated Tin Smelters

In his statement for the year 1957/58, Mr. C. Waite, chairman of the company, says that in view of the control of tin exports the tonnage to be received by the company's works during its current year, will be substantially reduced, and while this reduction lasts, profits must be severely curtailed. Commenting on the tin price since export control, Mr. Waite goes on to say that the uncertainty regarding the future volume of Russian sales has undoubtedly depressed the London market during the last six months, but the most important factor has been the very low rate of demand in the U.S.A. as a result of the recession there. The market had also had to absorb several months of unrestricted production due to the "pipeline" length between some mines and world markets.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Jackson Metals (Birmingham) Limited (606636), 539 Lichfield Road, Aston, Birmingham, 6. Registered June 19, 1958. To carry on business of buyers and sellers of and dealers in residual and metals, etc. Nominal capital, £1,000 in £1 shares. Directors: Archibald Jackson and Mrs. Elsie V. Jackson.

Bradford Metal Spinning Co. Limited (606790), Farnham Road Works, Great Horton, Bradford. Registered June 23, 1958. Nominal capital, £3,000 in £1 shares. Directors: Frederick Moore and Frederick Moore, jun.

Crown Street Rag and Metal Merchants Limited (606914), 1-2 Crown Buildings, Crown Street, S.E.5. Registered June 25, 1958. Nominal capital, £100 in £1 shares. Directors: Stuart A. Sharer and Gerald J. Caplan.

Engineering Reclamation Co. Limited (607050), 36 Waterloo Street, Birmingham, 2. Registered June 26, 1958. To carry on business of scrap metal merchants, etc. Nominal capital, £1,000 in £1 shares. Director: Donald Macmillan.

H. E. Peace (Deritend) Ltd. (607090), 180 High Street, Deritend, Birmingham. Registered June 27, 1958. To take over business carried on at Deritend, Birmingham, by Harold E. Peace; to carry on business of general sheet metal workers, dust extractors and ventilating plant manufacturers, etc. Nominal capital, £10,000 in £1 shares. Directors: Harold E. Peace, Harold A. Massey and Robert L. Holmes.

Foundry Metals Limited (607139), 1 Drapers Gardens, E.C.2. Registered June 30, 1958. Nominal capital, £1,000 in £1 shares. Directors: Geo. W. Slack, Mrs. Elsie M. Slack and Gordon S. Moore.

J. W. Rudge and Co. Limited (607184), 52 Great Hampton Street, Birmingham. Registered June 30, 1958. To take over business of a plater and polisher carried on by R. R. Blower as "J. W. Rudge and Co." at Birmingham, etc. Nominal capital, £1,000 in £1 shares. Directors: Ramon R. Blower and Irmgard H. K. Blower.

Porter Metal Works Limited (607786), 38 Ellin Street, Sheffield. Registered July 10, 1958. Nominal capital, £5,000 in £1 shares. Directors: Henry Waller, Mrs. Caroline Waller and Edward Waller.

Resistant Coatings Limited (607787), 31 High Street, Haddenham, Bucks. Registered July 10, 1958. To take over the business of electro platers carried on at Haddenham as "Rhodes and Soundy" by B. Rhodes. Nominal capital, £2,000 in £1 shares. Directors: Brian Rhodes and Hedley R. M. Anderson.

Kew Welding Company Limited (607801), 24 Windsor Terrace, Newcastle upon Tyne. Registered July 10, 1958. Nominal capital, £100 in £1 shares. Directors: Wm. H. Symons and Sidney A. Swayne.

D. Morton Limited (607815), 1 Newhall Street, Birmingham, 3. Registered July 10, 1958. To carry on the business of manufacturers of and dealers in metal and alloy goods, etc. Nominal capital, £1,000 in £1 shares. Directors: Dennis Morton and Pauline M. Such.

THE STOCK EXCHANGE

Metal And Engineering Shares Continued To Improve

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 5 AUGUST	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	21/-	+3d.	9	10	8 11 6	21/3	17/6	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	50/-		15	15	6 0 0	52/3	46/6	72/3	47/9
1,590,000	1	Birfield Industries	52/-	—3d.	15	15	5 15 6	57/-	46/3	70/-	48/9
3,196,667	1	Birmid Industries	71/6	+1/6	17½	17½	4 18 0	71/6	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	29/3	+1/3	10	8	6 16 9	29/3	23/9	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½		6	6	7 4 3	17/-	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	24/-	—3d.	12½	12½	10 8 3	28/9	24/-	30/3	28/9
300,000	1	Ditto Pref. 5%	15/-		5	5	6 13 3	16/-	15/-	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/-		7	7	7 0 0	19/4½	19/-	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	51/6	+3/9	12	12	4 13 3	51/6	36/6	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	18/9	—3d.	6	6	6 8 0	19/3	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/6	+3d.	12½	12½	5 17 9	45/6	38/9	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	37/-	—9d.	10	10	5 8 0	37/-	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	20/6	+6d.	25+ *2½C	25	6 2 0	21/-	19/7½	24/6	19/3
60,484	1/-	Carr (Chas.)	1/6		25	25	11 13 3X	2/3	1/9	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/1½		25	25	12 2 6	4/9	4/1½	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	19/-		10	10	10 10 6	19/-	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/9		6	6	7 12 6	15/10½	15/7½	17/6	16/-
250,000	2/-	Coley Metals	2/10½	+1½d.	20	25	13 18 3	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	47/3	—9d.	18¾	22½	7 18 9	51/6	41/-	92/6	49/-
1,136,233	1	Davy & United	62/-		20	15	6 9 0	62/-	45/9	60/6	42/6
2,750,000	5/-	Delta Metal	19/4½	+1½d.	30	*17½	7 14 9	21/4½	17/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	32/6	+1/3	12½	15B	7 13 9	34/-	22/9	38/6	25/-
750,000	1	Evered & Co.	27/9		15Z	15	7 4 0	28/3	26/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	34/9		12½	14	6 7 0X	38/7½	29/6	59/-	38/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	31/3		20	17½	6 8 0	34/7½	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/-		15	15	4 15 3	66/3	63/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	5/6		11½	11½	10 9 3	6/6	5/6	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	14/-		20	20	7 2 9	14/1½	12/10½	18/-	12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	24/3		13‖	18Z	5 7 0	24/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	48/3		20	17½	8 5 9	49/3	45/-	50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	13/3	+3d.	*15	*15	5 13 3	13/6	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/-		7	7	7 7 3	19/-	18/9	22/3	18/7½
1,075,167	5/-	Heenan Group	7/9	+3d.	10	20‡	6 9 0	7/9	6/9	10/4½	6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	29/10½	+7½d.	12Z	10	5 7 0	30/4½	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/-	—1½d.	5	5	6 5 0	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	151½	—¾	$3.75	$3.75	4 8 6	152	132¾	222	130
430,000	5/-	Jenks (E. P.), Ltd.	7/6		27½ϕ	27½	9 3 3	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/-	17/-	14/6
3,987,435	1	Ditto Ord.	37/-	—6d.	10	10	5 8 0	45/3	36/6	58/9	40/-
600,000	10/-	Keith, Blackman	20/-		17½	15	8 15 0	20/-	15/-	21/9	15/-
160,000	4/-	London Aluminium	4/3		10	10	9 8 3	4/4½	3/-	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	45/3		12½	12½	5 12 6	45/-	39/9	54/6	41/-
400,000	1	Ditto Pref.	23/3		7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	34/3		15	15	8 15 0	35/-	32/-	48/9	37/6
1,530,024	1	Ditto A Ord.	33/-		15	15	9 1 9	33/-	30/-	47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	10/6	+6d.	20	27½‡	9 10 6	10/9	8/9	21/10½	7/6
50,628	6/-	Ditto (7½% N.C Pref.)	5/9		7½	7½	7 16 6	6/3	5/9	6/6	5/-
13,098,855	Stk. (£1)	Metal Box	53/6		11	11	4 2 3	54/3	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	7/7½	+1½d.	50	50	13 2 3	7/7½	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	20/1½	+10½d.	10	10	9 18 9	22/9	19/-	25/-	21/6
80,000	5	Ditto Pref. 6%	79/6		6	6	7 11 0	83/6	79/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	38/3	+3d.	10	10	5 4 6	40/-	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/-	—3d.	5½	5½	6 9 6	17/3	17/-	19/3	16/-
2,200,000	Stk. (£1)	Murex	49/6	—1/3	17½	20	7 1 3	58/9	49/6	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	8/6		10	10	5 17 9	8/7½	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	25/6		20	27½D	7 16 9	27/-	24/6	41/-	24/9
1,365,000	Stk. (5/-)	Serck	14/9		17½Z	15	3 19 3	14/9	11/-	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	56/3	+1/3	18	16	6 8 0	56/3	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	23/-	—1/-	6½	6½	5 13 0	24/-	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	55/-		15	15	5 8 6	55/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	32/9	+9d.	10	10	6 2 3	32/9	28/9	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/-		5	5	6 13 3	15/6	14/9	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3	—6d.	*5	*5	7 6 3A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	78/3	+3d.	20	15	5 2 3	79/-	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	37/6	—3d.	10	18P	5 6 9	40/-	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	7/3		25	40	6 18 0	8/-	7/1½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	18/1½	—1½d.	27½	27½	7 11 9	18/3	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/7½		20	17½E	13 15 9	3/9¾	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	11/6	11/3	12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		27	40D	9 7 9	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.